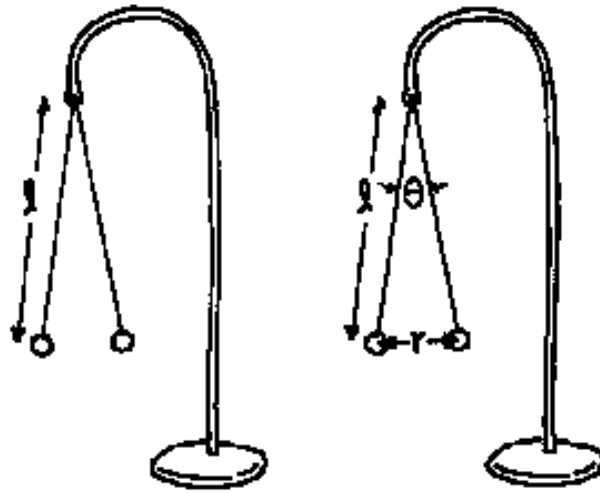
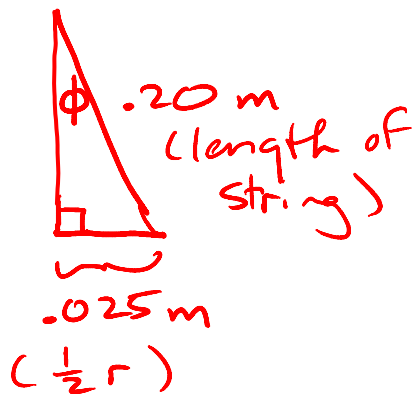


**Example 5.** Examine the electroscope arrangement below, where two pith balls have identical charges and are repelling each other.



If each string has a length  $l = 0.20$  m, the distance of separation between the charged pith balls is  $r = 0.05$  m, and the mass of the balls is  $0.010$  kg each, find the magnitude of the charge on each pith ball.

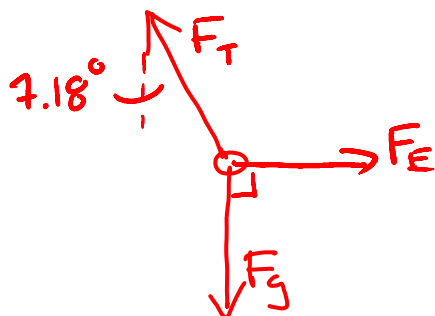
Start: find  $\frac{Q}{2}$  (called " $\phi$ ")



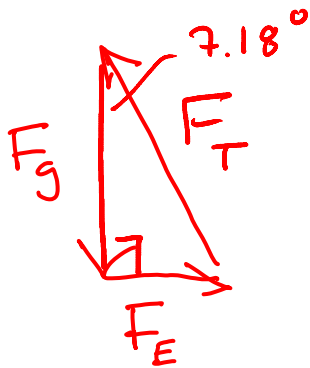
$$\sin \phi = \frac{.025}{.2}$$

$$\phi = 7.18^\circ$$

Next: draw a f.b.d. of one pith ball:



→ since pith ball is stationary, draw a forces triangle to show how the 3 forces cancel out:



$$\Rightarrow \frac{F_E}{F_g} = \tan \theta$$

$$\Rightarrow F_E = (.010)(9.8) \tan 7.18$$
$$= .0123 \text{ N}$$

Finally,

$$F_E = \frac{kQq}{r^2} = \frac{kQ^2}{r^2} \rightarrow \text{charges are equal}$$

$$.0123 = \frac{(9 \times 10^9) Q^2}{.05^2}$$

$$Q = 5.9 \times 10^{-8} \text{ C}$$

Note: the repulsive nature tells us each force has the same charge, but the type of charge (+ or -) is unknown.